# SYSTEMS ENGINEERING PLAN (SEP)

# PREPARATION GUIDE


***"Systems Engineering for Mission Success"***

**VERSION 0.95**

**MAY 10, 2005**

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## 1.0 Purpose of the Guide

This document guides program teams in generating their program's Systems Engineering Plan (SEP) regardless of the ACAT level of the program. This Guide provides an approach for organizing, compiling, and writing a SEP. It describes the key information to include in a SEP; it is not a tutorial on how to accomplish the systems engineering activities discussed in the Plan. The SEP is a "living" document that captures a program's current and evolving systems engineering strategy and its relationship with the overall program management effort. The SEP purpose is to guide all technical aspects of the program. It should be established early in the Concept Refinement phase and updated continually. The level of fidelity and emphasis will evolve as the program progresses through its lifecycle. It provides a comprehensive, integrated technical plan that reflects the program's strategy to achieve its objectives within acceptable risks. Throughout the Guide are links to the appropriate reference material that will give the program team additional information regarding the key systems engineering activities within the systems engineering strategy.

The Guide will assist the program team in meeting the policy directives of the February 20, 2004, USD(AT&L) Memorandum, "Policy for Systems Engineering in DoD," and March 30, 2004, OUSD(AT&L) Memorandum, "Implementing Systems Engineering Plans in DoD—Interim Guidance." The Guide contains general guidance, submittal instructions, and specific preparation guidelines, including a preferred format for a SEP.

The OSD office of primary responsibility (OPR) for this Guide is OUSD(AT&L) Defense Systems, Systems Engineering, Enterprise Development (OUSD(AT&L) DS/SE/ED). This office will develop and coordinate updates to the Guide as required, based on policy changes and customer feedback. To provide feedback to the OPR, please e-mail the office at ATL-ED@osd.mil.

## 2.0 General Guidelines and Submittal Instructions

Appropriate links are included throughout this guide to more specific guidance found elsewhere or in the *Defense Acquisition Guidebook* (DAG). The DAG references are made using the following format: {Ref DAG, Sect 4.1} means reference the Defense Acquisition Guidebook, Chapter 4, *Systems Engineering*, Section 4.1, *Systems Engineering in DoD Acquisition*.

### 2.1 General Guidelines

The SEP is the blueprint for the conduct, management, and control of the technical aspects of an acquisition program from conception to disposal, i.e., how the systems engineering process is applied and tailored to meet each acquisition phase objectives. The process of developing and coordinating the SEP forces thoughtful consideration, debate, and decisions to produce a sound systems engineering strategy for a program commensurate with the program's technical issues, lifecycle phase, and overall objectives. Thus, the SEP should be tailored to the specifics of the program.

The SEP is the one document that defines the methods by which system requirements, technical staffing, and technical management are to be implemented on a program, addressing the government and all contractor technical efforts {Ref DAG Sect 4.2.3.2}. The SEP should be

jointly developed by the government and contractor(s). The planning documented in the SEP should include:

1. What are the system capabilities, requirements, and associated design considerations to be addressed, hereafter referred to as "Requirements?"
2. What is the organizational integration necessary to address these Requirements, defining the systems engineering organization and infrastructure needed to include staffing, individual and organizational responsibilities and authorities, and training needs?
3. What is the engineering effort required, work products required, and schedule to achieve the Requirements?
4. How will the technical effort be managed and by whom, including technical baseline implementation and control and technical reviews planned to include what metrics, event-driven entry criteria, and exit criteria will be used?
5. How will the SEP link with other technical and programmatic planning efforts (e.g., the program acquisition strategy, Test and Evaluation Strategy (TES), Test and Evaluation Master Plan (TEMP), risk management, contract management, and financial management)?

These items convey the core information needed to understand the systems engineering approach planned for a program: What are the technical issues, who has responsibility and authority for managing the technical issues, what processes and tools will be used to address the technical issues, how will that process be managed and controlled, and how is that technical effort linked to the overall management of the program? This is the preferred content of a SEP as described in further detail in Section 3.0 Preferred Format and Specific Preparation Guidelines.

The SEP is updated continually based on the technical progress achieved to date in the program, reflecting changes in the technical approach stemming from the findings and results of the program's technical reviews, program reviews, acquisition milestones, or other program decision points. As a minimum, the SEP is submitted for MDA approval at each major program milestone.

## 2.2 Submittal and Approval Instructions

For ACAT ID and ACAT IAM programs, the SEP is submitted to the Milestone Decision Authority (MDA):

- By the appropriate Component Acquisition Executive (CAE) or designated representative,
- Not later than 30 days prior to the milestone decision point or subsequent program initiation if a program manager must have an OSD-approved document by the decision date, and
- Through the appropriate OUSD(AT&L) Defense Systems, Systems Engineering, Assessments and Support (OUSD(AT&L) DS/SE/AS) Program Support Team Lead, who will forward the SEP to the appropriate Overarching IPT (OIPT) leader for endorsement to the MDA.

For non-ACAT ID or IAM programs, the component MDA will designate the SEP approval authority and prescribe submittal instructions.

## 3.0 Preferred Format and Specific Preparation Guidelines

This section provides the preferred format for the SEP title and coordination pages, preferred format of the SEP, and detailed instructions for each section of the preferred SEP table of contents. The program team may tailor the SEP contents and coverage to the needs and complexity of the specific program, including the need to simply update existing legacy planning documents to the required content (e.g., Systems Engineering Management Plan (SEMP)); and in accordance with the direction of the MDA or designated SEP approval authority.

### 3.1 Title and Coordination Pages

Figures 1 and 2 illustrate the preferred title and coordination pages for an ACAT ID or ACAT IAM program. The minimum information to include on the title page is the program name, the version number of the document, what milestone this version supports, and the date. There is no prescribed title (i.e., SEP versus SEMP) or format version (you should provide a change log table so that reviewing authorities can understand the format adopted (see Section 3.3.3 Approach for SEP Updates)).

The coordination page should include the same information as the title page, followed by the signature blocks for the submitting officials, the concurrence officials at the program executive office or equivalent level, the component approving level, and OSD concurrence, as shown in Figure 2. This coordination page should be tailored based on the approved reporting chain directed by the MDA.

For those all other ACAT programs, components may adapt these pages accordingly in accordance with component MDA or designated SEP approval authority direction.

PROGRAM NAME

SYSTEMS ENGINEERING PLAN (SEP)

VERSION

MILESTONE SUPPORTING

DATE

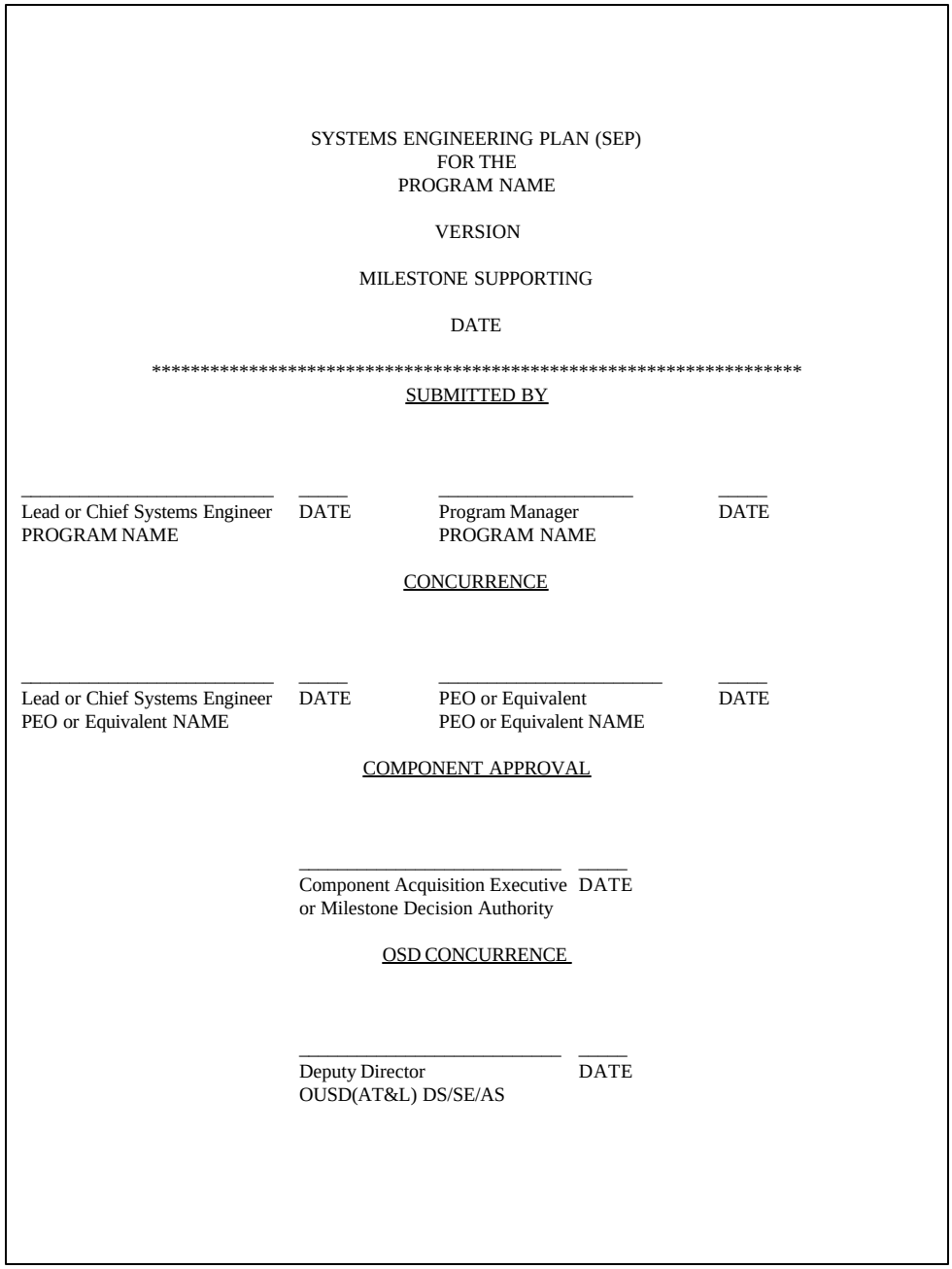
**********

OSD APPROVAL

_____ _____

Milestone Decision Authority DATE
or Designated SEP Approval Authority

**Figure 1 Preferred SEP Title Page**



SYSTEMS ENGINEERING PLAN (SEP)
FOR THE
PROGRAM NAME

VERSION

MILESTONE SUPPORTING

DATE

**********

SUBMITTED BY

| | | | |
|---|---|---|---|
| _____ | _____ | _____ | _____ |
| Lead or Chief Systems Engineer<br>PROGRAM NAME | DATE | Program Manager<br>PROGRAM NAME | DATE |

CONCURRENCE

| | | | |
|---|---|---|---|
| _____ | _____ | _____ | _____ |
| Lead or Chief Systems Engineer<br>PEO or Equivalent NAME | DATE | PEO or Equivalent<br>PEO or Equivalent NAME | DATE |

COMPONENT APPROVAL

| | |
|---|---|
| _____ | _____ |
| Component Acquisition Executive<br>or Milestone Decision Authority | DATE |

OSD CONCURRENCE

| | |
|---|---|
| _____ | _____ |
| Deputy Director<br>OUSD(AT&L) DS/SE/AS | DATE |

**Figure 2 Preferred SEP Coordination Page**

### 3.2 Table of Contents

The preferred format for the SEP is shown in Figure 3. The format is tailorable based on the needs of the program.

1. Title and Coordination Pages
2. Table of Contents
3. Introduction
    - 3.1 Program Description and Applicable Documents
    - 3.2 Program Status as of Date of This SEP
    - 3.3 Approach for SEP Updates
4. Systems Engineering Application to Life Cycle Phases
    - 4.1 System Capabilities, Requirements, and Design Considerations
        - Capabilities to be Achieved
        - Key Performance Parameters
        - Certification Requirements
        - Design Considerations
    - 4.2 SE Organizational Integration
        - Organization of IPTs
        - Organizational Responsibilities
        - Integration of SE into Program IPTs
        - Technical Staffing and Hiring Plan
    - 4.3 Systems Engineering Process
        - Process Selection
        - Process Improvement
        - Tools and Resources
        - Approach for Trades
    - 4.4 Technical Management and Control
        - Technical Baseline Management and Control (Strategy and Approach)
        - Technical Review Plan (Strategy and Approach)
    - 4.5 Integration with Other Program Management Control Efforts
        - Acquisition Strategy
        - Risk Management
        - Integrated Master Plan
        - Earned Value Management
        - Contract Management

**Figure 3 Preferred SEP Format**

### 3.3 Introduction

The introductory section of the SEP should convey the essential elements of the program—system description, referencing other applicable major program documents and the hierarchy of those documents; program technical status at the time of SEP submittal; and the overall approach for updating the SEP.

### 3.3.1 Program Description and Applicable Documents

This section provides a top-level system description and should convey the overall key aspects of the program. The system description should include any family-of-systems or system-of-systems relationships, as applicable {Ref DAG Sect 4.2.6}. If more detailed information is required, incorporate it by referencing the documents that contain the information. Every effort should be made to reference existing program documentation within the SEP. This section should refer to other program documents, as appropriate (e.g., program ICD, CDD, or CPD; Acquisition Strategy; Technology Development Strategy; Integrated Master Plan (IMP) and Integrated Master Schedule (IMS), including the schedule for contractor, developmental, and operational testing; and the TES or TEMP, as appropriate, for the current phase of the program). For family-of-systems or system-of-systems programs, related SEPs should also be cross-referenced. This section should also provide the hierarchy of these documents and list the point of contact for each.

### 3.3.2 Program Technical Status as of Date of the SEP

This description includes the program's technical status as of date of the SEP to include current life-cycle phase, past milestones achieved, critical path events, and upcoming major milestones. This section is cumulative, providing an update rather than replacement of status previously provided. The description should include status of deliverables or key events required by other programs in order to field a complete, family-of-systems or system-of-systems mission capability, if applicable.

### 3.3.3 Approach for SEP Updates

Describe the approach for updating the SEP given that it is a "living" document. The description should list the primary sources and event triggers for SEP updates {Ref DAG Sect 4.5.1}, list previous SEP submittals by date, and include a change log table.

## 3.4 Systems Engineering Application to Life Cycle Phases

This section should be broad in scope and as comprehensive as the program's maturity allows, describing the top-level systems engineering process for the system's upcoming lifecycle phase (i.e., Concept Refinement, Technology Development, System Development and Demonstration (SDD), Production and Deployment, or Operations and Support (O&S)). The description should address how the SE process will be integrated into a lifecycle model for each acquisition phase to include how the process will be tailored to meet individual acquisition phase objectives and support the technical and programmatic products required of each phase {Ref DAG Sect 4.3}.

The plan should provide both a historical and planned SE process overview—what has been done to date and what is planned for the future with more detail provided on the next immediate lifecycle phase than subsequent phases. In subsequent revisions, any changes to the prior SEP and planned events, etc., should include a brief explanation of what drove the change (e.g., new direction or requirements, funding issues, technical issues, or normal program maturation, etc.).

### 3.4.1 System Capabilities, Requirements, and Design Considerations

This section outlines the overall capabilities, concept(s) of operation, and Requirements (specified and derived) of the program, as appropriate. This section provides the reader a basic understanding of the problem at hand. The minimum information to convey is:

- Capability required and operational concept(s) (if appropriate, the JROC approved Concept of Operations), referencing the appropriate JCIDS documents (e.g., ICD, CDD, or CPD) {Ref CJCSM 3170.01 and DAG Sect 4.1.3};
- The Key Performance Parameters (KPPs) and the rationale and basis for the KPPs {Ref CJCSM 3170.01};
- Certification Requirements: describe the mandatory certification requirements levied on the program at each level of development (i.e., element, system, integration, interoperability, joint, and coalition), including the applicable source for the certification requirement (e.g., statute, regulation, or instruction); and
- Design considerations: for any special design considerations that must be integrated into the engineering design effort, describe the basis and how the technical authority is going to be engaged {Ref DAG, Sect 4.4}.

### 3.4.2 Systems Engineering Organizational Integration

This section delineates how the systems engineering effort will be integrated organizationally to accommodate the appropriate technical authorities and engineering specialties commensurate with the Requirements of the program as outlined in Section 3.4.1 System Capabilities, Requirements, and Design Considerations above {Ref DAG Sect 4.1.6}. This includes a plan for organizational structure and staffing and the responsibilities for technical management, systems engineering, and test and evaluation to include any hiring implications and additional training requirements.

This section of the plan should include:

- The overall organization of the systems engineering effort, including delineation of authorities, responsibilities, and integration across the government and contractor boundaries from prime contractor down to the lowest level supplier;
- The authorities and role of the chief or lead systems engineer and systems engineering teams (e.g., the Systems Engineering and Integration Team or integrated product teams (IPTs));
- The staffing levels, training, and experience needed to execute the required systems engineering effort;
- How the systems engineering structure is organized to provide technical management guidance across the government, prime contractor, subcontractors, and suppliers;
- How technical authority will be implemented on the program to address the full spectrum of program Requirements outlined in Section 3.4.1 System Capabilities, Requirements, and Design Considerations; and
- For family-of-systems and system-of-systems efforts, how the program-level systems engineering efforts are integrated with higher-level systems engineering authorities.

### 3.4.3 Systems Engineering Process

This section should delineate the SE process to be used on the program, including the basis for selection (e.g., commercial standard, organizational process, etc.), the purpose and objectives of the process {Ref DAG Sects 4.2.3 and 4.2.4}, and the technical authority responsible for implementation (e.g., who is responsible for airworthiness certification). The plan should address any planned process improvement activities as well as the program's approach to ensuring adherence to established processes. This section should identify those approaches previously enacted that have not been successful and what changes are being put in place as of this update to improve the approach.

The plan should discuss how the size, effort, and schedule for the systems engineering effort are developed, and how it is adequate to allow for disciplined application of the planned systems engineering process. It should also include the method of resource allocation to technical tasks to include resource-requirements identification, procedures for resource control, and reallocation procedures to include:

- Facilities and tools employed for each process and phase (for new facilities providing a facility development plan to include any facility software development),
- Facilities and tools employed by systems engineering personnel, and
- Integration of tools between functions and between organizations.

Briefly provide an overview of the key technical objectives, deliverables and results from the process, needed process inputs, and the product work breakdown structure (WBS) development. The description should also include an overview of the TES or TEMP, demonstrating how the test and evaluation strategy meshes with the systems engineering efforts, and the overall program test and evaluation schedule to include platform-level, interoperability, joint, and coalition test and certification, as applicable.

This section should describe the program's intended use of modeling and simulation (M&S) to facilitate the systems engineering process throughout the system's lifecycle. It should specifically address M&S application during concept refinement {Ref DAG Sect 4.5.7.1}, development {Ref DAG Sects 4.5.7.2 and 4.5.7.3}, testing {Ref DAG Sect 4.5.7.3}, production {Ref DAG Sect 4.5.7.4}, and operations and support {Ref DAG Sect 4.5.7.5}, as appropriate for the current and pending phases of the program's lifecycle. The plan should include the program's strategy for managing the M&S activities for optimum cost-effectiveness and describe how the program will avoid duplication of efforts by reusing M&S resources. This section should also address M&S tool procurement, development, maintenance, data management, verification, validation, and accreditation.

This section also describes what studies have been and will be conducted, who did or will conduct them, how they were or are to be conducted to include a discussion of trades as part of a family-of-systems or system-of-systems solution, if applicable {Ref DAG Sect 4.3}, and who is responsible for making trade-off decisions and at what level in the organization that decision maker resides. Further, it should describe the intended use of criteria for decision-making and trade-off of alternative design solutions, including a description of technical objectives, criteria and weighting factors, and utility curves, as applicable.

Early in a program's lifecycle, this description should include an overview of the approach and methods planned for use in arriving at a balanced set of requirements and a balanced functional and design architecture to satisfy those requirements. It should also describe

what mission analysis techniques (e.g., modeling and simulation) are planned for use in the Analysis of Alternatives (AoA) and how that supports the evolution of requirements in the ICD, CDD, and CPD.

The plan should also provide an overview of the methods and tools specific systems analyses needed (e.g., hardware, software, human allocation, trade-off analyses, systems and cost effectiveness, cost benefit, and risk impact analyses). It should describe the studies planned for making trades among:

- Stated requirements;
- Design;
- Project schedule;
- Functional and performance requirements;
- Function;
- Task; and
- Decision allocation among human, software, and hardware and lifecycle and design to cost.

For programs later in the lifecycle, include the approach for progressing through the typical systems engineering steps: requirements analysis, decomposition, allocation, and analysis. The description should summarize prior trade studies and how they have steered the technical and programmatic changes to the program.

The plan should include the intended measures of effectiveness (MOEs), how they interrelate, and criteria for the selection of measures of performance (MOPs) to support the evolving definition and verification of the system. The description should include the overall approach for all planned analyses (e.g., system cost-effectiveness, manufacturing, verification, distribution, operational, human engineering, manpower, personnel, training, usability, supportability, safety, health hazards, environmental, and lifecycle cost analysis). Finally, it should describe how the analytical results are integrated and the criteria used; rationale for the solution; and how performance requirements, lifecycle costs, etc, will be considered.

### 3.4.4 Technical Management and Control

This section describes the approach for controlling the overall technical effort of the program, including the technical baseline control and requirements management, traceability, and requirements verification; and technical reviews.

It should delineate who has the responsibility for technical baseline management and control, how the generation of specifications and baselines will be managed and controlled, and identifies by name the specification documents that require development and those which currently exist as legacy requirements and specifications {Ref DAG Sects 4.2.3.6, 4.2.3.7, and 4.2.3.8}. If appropriate, the description should include the approach for documenting and controlling baselines developed as part of a family-of-systems or system-of-systems solution.

The plan should include:

- How each technical baseline is developed, managed, and used to control system requirements, design, integration, verification, and validation to include change control strategy for baselines and configurations and specific products that constitute the technical baseline;

- The technical objectives related to success of the project, system, and system effectiveness (e.g., software development metrics, technical performance measures (TPMs), Critical Technical Parameters (CTPs), MOEs, measures of suitability (MOSs), and MOPs) that indicate technical progress, design maturity, and achievement of performance and technical objectives (include system or configuration item parameters or both) and a discussion of technical performance measurement update frequency, tracking depth, response time to generate recovery plans and planned profile revisions, and the risks related to parameter descriptions;
- The approach for requirements traceability and requirements verification and validation traceability, describing the tools and methods that were or will be used to show traceability of TPMs to the KPPs and between JCIDS requirements documents (ICD, CDD, or CPD) and system performance specifications (e.g., Prime Item Development Specification or Commercial Item Description, etc.);
- The planned achievement-to-date assessments to support cost reporting and event driven schedule; and
- Overview of government and contractor data rights for the system to include what key technical information and data (capabilities, concept descriptions, system concepts definitions, operational requirements, performance requirements, KPPs, concept of operations) will be developed during this phase.

This section should also describe the approach and strategy for implementing technical reviews, and address how the overall review process demonstrates completion of required accomplishments by satisfying criteria in an event-driven schedule {Ref. DAG Sects 4.2.3.3, 4.3, 4.3.1.4, 4.3.2.4, 4.3.3.4, 4.3.3.9, 4.3.4.4, 4.3.5.4, 4.5.1, and 4.5.8}. The overall technical review approach selected is tailorable based on the complexity of the program. The key information to convey in this section is how the lead or chief systems engineer will use each technical review to assess technical maturity, assess risks {Ref DAG Sects 4.2.3.5 and 11.4}, and support program decisions at the overall system level and down to configuration items of the system. The plan should describe how technical reviews will enable an independent assessment of emerging designs against the plans in order to demonstrate and confirm completion of required accomplishments and readiness to proceed to the next key milestone. This is especially important for evolutionary acquisition strategies, using spiral development processes, or multi-component programs (family-of-systems or system-of-systems programs). The technical review approach should be integrated across the government, contractor, and lowest level of supplier.

This section should address contractual, workforce, and schedule resources required to adequately implement the technical review process. The description should include:

- The technical review membership composition, including the method for nominating and approving the chairperson and membership {Ref DAG Sect 4.1.6};
- The roles and responsibilities of those involved in conducting technical reviews, and outline the procedures they will use in conducting the reviews;
- The number of technical reviews planned, to what WBS-level;
- The entry and exit criteria for each review;
- The timing of each review; and
- How technical reviews are used to manage the technical effort.

### 3.4.5 Integration with Other Program Management Control Efforts

This section describes the relationship and feedback mechanisms between the systems engineering and key program management processes that are closely interrelated: acquisition strategy, risk management, program management plan or integrated master plan, earned value management system (EVMS), and contract management. This section should describe:

- How the program's selected acquisition strategy is based on the technical understanding of the problem at hand as described in Section and the identified program risks to include the list of program risks {Ref DAG Sects 4.0 and 4.3};
- What are the linkages between the systems engineering technical risk assessment and mitigation efforts and the overall risk management process {Ref DAG Sects 4.2.3.5 and 11.4};
- What is the integration of SE activities into the overall program management effort through the program management plan or integrated master plan and integrated master schedule {Ref DAG Sect 11.3};
- What systems engineering efforts are included in the EVMS measurement baseline and how earned value is mapped to the technical reviews {Ref DAG Sec 11.3.1}; and
- How the systems engineering data and decisions feed other program activities and vice versa?

This section should also describe how the contract, subcontract, and supplier, if applicable, systems engineering efforts are managed. This plan should include:

- How sources will be selected {Ref DAG Sect 4.2.5};
- What is the approach for contractor award fees and performance incentives;
- For interdependent, family-of-systems, or system-of-systems programs, what are the contracting strategies for incentivizing industry-to-industry to include associated contractor agreements (ACA) and award fee considerations and how performance incentives are linked or inter-related to optimize top-level system performance?

## 4.0 Acknowledgements

The OUSD(AT&L) Director, Defense Systems acknowledges the significant contributions from the Service and Component members of the Systems Engineering Plan Working Group (SEPWG). Their contributions made this product viable, and their continued dedicated support will facilitate achievement of OUSD(AT&L) Goal 3, "*Systems Integration and Engineering for Mission Success*."

## 5.0 Acronyms

| | |
|---|---|
| ACA | Associated Contractor Agreements |
| ACAT | Acquisition Category |
| CAE | Component Acquisition Executive |
| CDD | Capability Development Document |
| CPD | Capability Production Document |
| CTP | Critical Technical Parameter |
| DAG | Defense Acquisition Guidebook |

| | |
|---|---|
| EV | Earned Value |
| EVMS | Earned Value Management System |
| HSI | Human Systems Integration |
| ICD | Initial Capabilities Document |
| IMP | Integrated Master Plan |
| IMS | Integrated Master Schedule |
| IPT | Integrated Product Team |
| JCIDS | Joint Capabilities and Integration Development System |
| KPP | Key Performance Parameter |
| MDA | Milestone Decision Authority |
| M&S | Modeling and Simulation |
| MOE | Measure of Effectiveness |
| MOP | Measure of Performance |
| MOS | Measure of Suitability |
| OPR | Office of Primary Responsibility |
| OSD | Office of the Secretary of Defense |
| OUSD(AT&L) | Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics |
| O&S | Operations and Support Phase |
| PEO | Program Executive Office or Program Executive Officer |
| PST | Program Support Team |
| SDD | System Development and Demonstration Phase |
| SE | Systems Engineering |
| SEMP | Systems Engineering Management Plan |
| SEP | Systems Engineering Plan |
| SEPWG | Systems Engineering Plan Working Group |
| TEMP | Test and Evaluation Master Plan |
| TES | Test and Evaluation Strategy |
| TPM | Technical Performance Measure |
| USD(AT&L) | Undersecretary of Defense for Acquisition, Technology, and Logistics |
| VV&A | Verification, Validation, and Accreditation |
| WBS | Work Breakdown Structure |